WHAT IS CLAIMED IS:

1.   1. A method for performing a measurement related to a volume of fluid in a region inside a

2.   thorax of a body, comprising:

3.   injecting an electrical current between first and second internal electrodes positioned

4. such that a portion of the injected current flows through at least a portion of the region, the

5. internal electrodes being implanted in the body;

6.   measuring a voltage between first and second external electrodes, the measured

7. voltage being induced by the injected current, the first and second external electrodes being

8. attached to an external surface of the skin of the body; and

9.   calculating a first impedance by taking the ratio of the measured voltage and the

10. injected current, wherein the calculated impedance is related to the volume of fluid in the

11. region.

12.   2. The method of claim 1, wherein the region is a lung.

13.   3. The method of claim 2, wherein the injection of current is accomplished by applying a

14.   voltage between the first and second internal electrodes using an implantable cardiac

15.   device.

16.   4. The method of claim 3, wherein the housing of the implantable cardiac device serves as

17.   the second internal electrode.

18.   5. The method of claim 4, wherein the first internal electrode is positioned epicardially over

19.   the left ventricle of the heart, and the second internal electrode is positioned near the

20.   upper portion of the left lung.

21.   6. The method of claim 5, wherein the first external electrode is attached to the anterior left

22.   shoulder region near the upper part of the lung, and the second external electrode is

23.   attached to the central dorsal region.

24.   7. The method of claim 2, wherein the injection of current is accomplished by applying a

25.   voltage between the first and second internal electrodes using an implantable cardiac

26.   device.

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1　8. The method of claim 7, wherein the implantable cardiac device is an implantable

2　　　cardioverter defibrillator.

3　9. The method of claim 7, wherein the implantable cardiac device is an implantable

4　　　pacemaker.

5　10. The method of claim 7, wherein the implantable cardiac device is an implantable cardiac

6　　　resynchronization therapy device.

7　11. The method of claim 7, further comprising measuring a lead impedance of the first and

8　　　second internal electrodes.

9　12. The method of claim 11, further comprising telemetering a voltage applied to inject the

10　　　current and the measured lead impedance to a device external to the body.

11　13. The method of claim 12, further comprising calculating the injected current by dividing

12　　　the telemetered voltage by the telemetered current.

13　14. The method of claim 4, further comprising:

14　　　　injecting a second electrical current between a third internal electrode and the second

15　internal electrode, the third internal electrode being implanted in the body and positioned

16　such that a portion of the injected current flows through at least a portion of the lung;

17　　　　measuring a second voltage between a third external electrode attached to the upper

18　right shoulder region and another of the external electrodes, the second measured voltage

19　being induced by the second injected electrical current.

20　15. The method of claim 14, wherein the third internal electrode is positioned in the right

21　　　atrium of the heart.

22　16. The method of claim 14 further comprising calculating a second impedance by taking the

23　　　ratio of the second measured voltage and the second injected current.

24　17. The method of claim 16, further comprising computing a weighted average of the first

25　　　and second calculated impedances.

18. The method of claim 17, further comprising comparing two weighted averages to detect changes in pulmonary edema.

19. The method of claim 1, further comprising telemetering information about the injected current to a device external to the body.

20. The method of claim 2, further comprising comparing a number of calculated impedances to detect a change in the volume of fluid in the lung.

21. The method of claim 20, further comprising detecting changes in pulmonary edema corresponding to changes in the calculated impedance.

22. An apparatus for performing a measurement related to a volume of fluid in a region inside a thorax of a body, comprising:

a receiver that receives information about an electrical current injected between first and second internal electrodes positioned such that a portion of the injected current flows through at least a portion of the region, the received information being telemetered from a device that injects the current, the device and the internal electrodes being implanted in the body;

an interface that receives a voltage signal detected by first and second external electrodes attached to an external surface of the skin of the body, the detected voltage being induced by the injected current; and

a processing unit that determines the fluid volume in the region by calculating a first impedance from the voltage signal and the received information about the injected current.

23. The apparatus of claim 22, wherein the region is a lung.

24. The apparatus of claim 23, further comprising an implantable cardiac device that applies a voltage between the first and second internal electrodes to accomplish the current injection.

25. The apparatus of claim 24, wherein a housing of the implantable cardiac device serves as the second internal electrode.

1 26. The apparatus of claim 25, wherein the first internal electrode is positioned epicardially
2   over the left ventricle of the heart, and the second internal electrode is positioned near the
3   upper portion of the left lung.

4 27. The apparatus of claim 26, wherein the first external electrode is attached to the anterior
5   left shoulder region of the body, and the second external electrode is attached to the
6   central dorsal region of the body.

7 28. The apparatus of claim 22, further comprising an implantable cardiac device that applies
8   a voltage between the first and second internal electrodes to accomplish the current
9   injection.

10 29. The apparatus of claim 28, wherein the implantable cardiac device is an implantable
11   pacemaker.

12 30. The apparatus of claim 28, wherein the implantable cardiac device is an implantable
13   cardioverter-defibrillator.

14 31. The apparatus of claim 28, wherein the implantable cardiac device is an implantable
15   cardiac resynchronization therapy device.

16 32. The apparatus of claim 28, wherein the second internal electrode comprises a housing of
17   the implantable cardiac device.

18 33. The apparatus of claim 28, wherein the implantable medical device measures a lead
19   impedance of the first and second internal electrodes.

20 34. The apparatus of claim 33, wherein the received information about the injected current
21   further comprises a telemetered value of the voltage applied to accomplish the current
22   injection and a telemetered value of the measured lead impedance.

23 35. The apparatus of claim 34, wherein the processing unit calculates the injected current by
24   dividing the telemetered voltage value by the telemetered lead impedance value.

25 36. The apparatus of claim 25, wherein the receiver receives information about a second
26   electrical current injected between a third internal electrode and the second electrode, the

1　third internal electrode being implanted in the body and positioned such that a portion of

2　the injected current flows through the lung, and wherein the interface receives a second

3　voltage signal detected by a third external electrode and the second external electrode, the

4　third electrode being attached to the skin in the suprasternal notch region, and the second

5　electrode being attached to the postero-lateral region of the right thorax, medially over

6　the ribs.

7　37. The apparatus of claim 36, wherein the third internal electrode is positioned in the right

8　atrium of the heart.

9　38. The apparatus of claim 36, wherein the processing unit calculates a second impedance by

10　taking the ratio of the second detected voltage and the second injected current.

11　39. The apparatus of claim 38, wherein the processing unit computes a weighted average of a

12　number of calculated impedances.

13　40. The apparatus of claim 39, wherein the processing unit compares two weighted averages

14　to detect changes in pulmonary edema.

15　41. The apparatus of claim 22, wherein the receiver receives telemetered information about

16　the injected current from an implantable medical device in the body.

17　42. The apparatus of claim 23, wherein the processing unit compares a number of calculated

18　impedances to detect a change in the volume of fluid in the lung.

19　43. The apparatus of claim 42, wherein the processing unit detects changes in pulmonary

20　edema corresponding to changes in the calculated impedance of the lung.